CURRICULUM VITAE
GARY J. PIERCE, Ph.D.
Principal Scientist, Froghome Environmental, LLC

Education

- B.S. 1968 - University of Wisconsin, Madison - Botany
- M.A. 1974 - Western Michigan University - Biology
- Ph.D. 1979 - University of Wyoming – Botany

Employment Experience

- Principal Scientist & Owner, Froghome Environmental, LLC, 2004 - present
- Director, Pierce Cedar Creek Institute, November 1998 - 2004
- President and Principal Scientist, Southern Tier Consulting, Inc., 1985 - 1998
- Consultant and owner of Southern Tier Consulting, 1984 - 1985
- Regional Manager, Environment Consultants, Inc., 1981 - 1983
- Associate Professor, Niagara University, 1980
- Assistant Professor, Niagara University, 1976 - 1980,

Areas of Specialization

- Wetland mitigation planning, permitting, and implementation
- Wetland mitigation education
- Biotechnical erosion control
- Wetland delineation, functional analysis, botany
- Wetland permitting, Local, State, and Federal
- Wetland hydrology
- Plant systematics

Selected Experience

- Project Manager and Instructor; Rutgers University. Wetland construction courses. (1992-2004)
- Project Manager and Instructor; Wetland Training Institute. Various courses on wetland restoration and construction. (1990 - 2004)
- Project Manager and Instructor; U.S. Corps of Engineers. Wetland Development and Restoration Courses and Biotechnical Erosion Control workshops sponsored by the U.S. Army Corps of Engineers Waterways Experiment Station. (1984 - 2004)
- Project Manager, and technician in charge; U.S. Generating Corporation, Rotterdam, NY. Preparation of comprehensive mitigation plan to replace impacted wetlands. Included mitigation for State special interest grass species (1991)
- Project Manager and technician in charge, in cooperation with Baker Engineering of Richmond, VA. Preparation of comprehensive mitigation plan for

US Army Corps of Engineers, Baltimore District, wetland mitigation for flood control project in Lock Haven, PA. Includes waterfowl habitat as emergent and shrub marsh and woodcock habitat. (1993 - 1994)

• Project Manager; Old Dominion Electric Cooperative, Clover, VA. Wetland mitigation planning, planting, and monitoring of 35 acre forested, shrub, and emergent wetland system. (1991 -1995)

• Project Manager; Jersey Central Power & Light Co., Tom's River, NJ. Wetland mitigation consulting, planting, and monitoring for a transmission line. The project involved revegetation of disturbed wetland areas along the right of way. (1988)

• Project Manager; IT Corporation, Princeton South, NJ. Design assistance and planting of a 10 acre mitigation wetland which included emergent and woody plantings. (1988)

• Project Manager/Principal Investigator; United States Department of Energy, Savannah River Plant, SC. Supply plants and plant wetland on over three linear miles of shoreline for a nuclear plant cooling reservoir in cooperation with the Savannah River Ecology Laboratory. (1986-1987)

• Project Manager/Principal Investigator; United States Army Corps of Engineers. Shoreline stabilization project on three reservoirs in Virginia, Nebraska, and Illinois (1989 - 1992)

• Project Manager; Linpro Corporation, Manahawkin, NJ. Wetland mitigation planning and planting for a 32 acre forested wetland. (1988)

• Project Manager; United States Army Corps of Engineers, Waterways Experiment Station, St. Louis District: Assistance with erosion control revegetation of Carlyle Lake Reservoir. (1988).

• Project Manager; New York State Department of Transportation. Wetland mitigation for construction of Highway 17 in Cattaraugus County, NY (1981 - 1984). Received nomination from Engineering News Record for Engineer of the Year for 1984 as the result of this project.

• Team Leader; Bielinski Homes. Wetland enhancement and restoration project for former peat mining site in Wakesha Co., Wisconsisn. (2004)

• Project Advisor; Timberline Resources, Billings, Montana. Wetland Mitigation Bank Design for Montana Department of Transportation. (2004-2006)

• U.S. District Court appointed mitigation supervisor for Rapanos Mitigation. (2003 - 2006)

Selected Publications

• Allen, H.H., G.J. Pierce, and R. Van Wormer. 1989. Considerations and techniques for vegetation establishment in constructed wetlands. pp.405-415. In D.A. Hammer (ed.) Constructed Wetlands for Wastewater Treatment. Lewis Publishers, Chelsea, Michigan.

• Pierce, G.J. 1978. Griffithsochloa, a new genus segregated from Cathestecum (Gramineae). Bulletin of the Torrey Botanical Club. 105:134-13 8.

• ______. 1981. The influence on flood frequency on wetlands of the Allegheny River floodplain in Cattaraugus Co., New York. Wetlands 1:87-104.

• ______. 1983. New York State Department of Transportation wetland construction. National Wetlands Newsletter. 5(6):12 - 13.
• ______. 1987. Wetland Demonstration Project - Contract No: D250336-CPIN 5 119.01.321 STE, Section 5P (A) Allegheny River Floodplain Cattaraugus County, New York. Prepared By: Southern Tier Consulting, Inc. and Ecology and Environment, Inc. for the New York State Department of Transportation. xiii+204 pp
• ______. 1988. In-kind vs. out-of-kind wetland replacement. pp 287-288. In J.A. Kusler, M.L. Quammen and G. Brooks, eds. Mitigation of Impacts and Losses, Proceedings of the National Wetland Symposium. Association of State Wetland Managers Technical Report 3.
• ______. 1988. Succession and stability in freshwater marshes in the northeastern United States. pp 323-324. In J.A. Kusler, M.L. Quammen and G. Brooks, eds. Mitigation of Impacts and Losses, Proceedings of the National Wetland Symposium. Association of State Wetland Managers. Technical Report 3.
• ______. 1989. Wetland soils. pp 65-74. In S.K. Majumdar, R.P. Brooks, F.J. Brenner, and R.W. Tiner, Jr., eds. Wetlands Ecology and Conservation: Emphasis in Pennsylvania. The Pennsylvania Academy of Science.
• ______. 1993. Planning Hydrology for Constructed Wetlands. Wetland Training Institute, Poolesville, MD. vi+49pp
• Wein, G. and G. Pierce. 1995. Case Study #1. pp. 13 - 35. In: M.M. Davis, ed. Native plant material sources for wetland establishment: Freshwater case studies. U.S. Army Engineer Waterways Experiment Station. Technical Report WRP-RE-5.
• Zander, R.H. and G.J. Pierce. 1979. Flora of the Niagara Frontier region - Second supplement and checklist. Bulletin of the Buffalo Society of Natural Sciences. Vol. 16 (Suppl. 2)

Award

Nominated as Engineer of the Year for 1982 by Engineering News Record Magazine - For wetland mitigation construction for the Southern Tier Expressway In Cataraugus County, New York.

Associations

- Society of Wetland Scientists
- Michigan Botanical Club

A Review of "The Impacts of Various Types of Vegetation Removal on Great Lakes Coastal Wetlands of Saginaw Bay and Grand Traverse Bay."

By

Gary Pierce, Ph.D.
Froghome Environmental, LLC
May 4, 2006

I have been asked by the board of directors of SOS (Save Our Shoreline) to review the document cited in the title of this report. My task has been to review the document and to comment on it as a scientific report. Before working on this report I have never worked for SOS nor had I formed a professional opinion regarding the management of the great lakes shoreline. I had formed an informal impression that during the past three to four years there has been considerable increase in wetland along the shore of Saginaw Bay in Bay County, Michigan, and that those wetlands appeared to be somewhat of a nuisance for land owners on the shore while being of some interest for the functions and values provided by the wetlands. I had never seen nor been aware of this report until asked to review it by SOS.

My comments here are not complete as my review of the report is ongoing and I will be preparing a more detailed commentary covering additional issues and expanding my comments on some of the issues cited below.

The site selection for this study, "The Impacts of Various Types of Vegetation Removal on Great Lakes Coastal Wetlands of Saginaw Bay and Grand Traverse Bay" (the report), resulted in 33 sites which were sampled in 2004 and 2005 (page 5, paragraph 4). There is, however, a significant discrepancy in the reporting on data from the sites. The sample sites are located in Figures 1, 2, and 3. Table one (below) shows the number of sites located in figures 1,2, and 3 alongside the number of sites from which data were analyzed, Figures 8, 9, 11, 12, 14, 15, 16, 17, and 18. Clearly, there is a discrepancy in the data, and before the statistical results can be understood this discrepancy must be explained. A table showing all 52 locations from which the data originate and how these data relate to the 33 cited study locations must be presented in order to understand the methods and conclusions of the report. To be clear by example, Table 1 shows that the report lists and maps 10 natural (these are the unmanaged controls for the paper's study) sites, but the figures showing the results of the data analysis show data reported from 20 unmanaged locations. This is an incomprehensible and incongruous discrepancy as reported and requires detailed explanation for this core analysis of the paper to be credible. The same problem is inherent in all of the remaining data summarized in Table 1.

Table 1. Number of study sites in location figures(1,2,3) vs. statistical analysis figures (8,9,11,12,14,15,16,17,18).

Described Management	Figs. 1,2,3	Figs. 8,9,11,12,14,15,16,17,18
Natural	10	
Unmanaged		20
Groomed	9	
Mowed	11	13
Raked		12
Handpulled		4
Filled	3	3
TOTAL	33	52

In addition to the discrepancies cited above, the sample sizes for filled and handpulled sites (table 1) are quite small and these samples call into question conclusions that are based on this small amount of data for these two treatments

As shown in the location figures (1,2, & 3), there are significant distances, as much as several miles, between some of the natural and treated sites. In the text on page, paragraph 2, line 14, the principal is stated that "sampling points representing different treatments were located as near as possible to each other, with additional physical sampling of the geomorphic context to determine if the treatments were geomorphically equivalent." On page 5, paragraph 2, line 5 the additional principle is stated, "The sampling was changed to allow nearby ownerships under different management regimes within **an ecologically similar area of shoreline** to be sampled to compare response of vegetation and sediments."[My emphasis]. The commitment is made to demonstrate shoreline morphology equivalence and ecological similarity between and among compared sites. Although the report discusses general morphological differences among large stretches of shoreline, no effort is made to report, as promised, on either ecological or morphological equivalence of any of the sites. Rather, long stretches of shoreline are stated to be similar, but no indication is given of even the simplest comparisons among sites such as listed here:

- water depth in the sample transect
- dimensions of the marshes
- vegetation of the specific marshes,
- presumed or actual (from aerial photographs) vegetation of the sites during high water vs. low water times in the lake
- ,plant density in and among the sites
- , use of the adjacent upland at the sample points
- disturbance of the sites from activities other than grooming such as boat launching, fire building, and recreational activities
- direction that the beach at the sample point faces in regard to prevailing winds

- offshore water depths
- the specific substrate at the sample points.

No photographs of the sites are provided and no specific locations enable the reader to understand either the most simple details of site ecology or geomorphology. There is simply no indication that statistically compared sites have a similarity making them comparable. For what we know from the divergent distances among sites, the factors that control the measured features of the sites do not have similar causes. We can not determine if the beach management is being tested or statistical test are of the divergent morphology and ecology of the sites.

On May 6, 2006, I visited all of the beach segments where the 33 sample sites are located in an effort to determine the probability of the sites having similar geomorphology and/or ecology. It is abundantly clear that the samples represent radically different areas of both beach morphology and ecology. Differences include the following factors:

- In only a few locations does vegetation extend into the flooded portion of the bay. In almost all locations the wetland extends no farther lakeward than the current water line or the upper edge of the wave run up zone.
- In a few locations there is no vegetation at all at the apparent known or presumed study site, and in talking to owners or others familiar with the study zones there has been no vegetation on three of the study sites for tens of years. And all three of these sites are sand beaches rising sharply form the high water zone and not providing a site where wetlands could occupy anything but a zone only a few (less than 10 feet) wide. Several sites north and south of Caseville are steep sandy beaches with no wetland vegetation but the dry beaches upslope from the water line are occupied only by the invasive Common Reed and native dune plants.
- Contrary to the claim of the report, page 4, paragraph 1, that the wetlands on the beaches have a gradient of water chemistry caused by lateral movement of groundwater from the shore through the marsh toward the lake, only 3 of the 33 reaches of shoreline that I examined showed any evidence of groundwater discharge, but this provided a unique geomorphologic context for about 10% of the sample sites.
- Some sites are occupied by wide zones of wetland plants on flat areas that are only slightly above the water line while others show wetland plants on a relatively short steeper gradient.
- Contrary to the claim of the report that three-square bulrush dominated all but 3 of 24 vegetated transects a number of the sites (seven) are dominated by common reed, and three others are vegetated and dominated by species other than common reed or three-square bulrush.
- Offshore water depth, the direction the shore faces, and the average fetch, are additional factors effecting the geomorphology and ecology of the sites. There is considerable difference among the sites in these factors.

- There is considerable difference among the natural soils of the sites ranging from wind blown and drifting sand to stable sandy silts providing for considerable differences in nutrition and soil stability both of which influence plant growth.

In the statistical section of the report in each analysis where there is significant difference there is no difference between the natural sites and the mowed sites but there is a statistical difference between the mowed and natural versus the raked, filled, and handpulled sites. The strong conclusion of this report, but not explicitly stated, is that mowing has no significant effect on any of the measured vegetation parameters. All conclusions of the report are, however, compromised by the failure of the report to provide information about sample sizes (Table 1) and the morphology and ecology of the individual sampling locations.

An important qualitative conclusion of the report is that many shoreline areas are not vegetated when the lake levels are high but become vegetated when the lake levels fall. One implication of this observation is that, in such areas, the removal of vegetation has no permanent effect on the ecology of the shoreline ecosystem. The conclusion has no relevance to shoreline areas that are permanently vegetated. This feature, of sites changing naturally over the periods of the lakes, elevation cycles, should have been investigated by specific comparisons including such naturally variable sites.

In conclusion:

1. The report is based on a large amount of data.
2. The report uses simple, readily comprehensible analyses.
3. The report makes some interesting and potentially valuable qualitative observations about the lakes' beach environments.
4. The reported sites are not confirmed to meet the criteria imposed on their selection by author himself, this calls into serious question all of the conclusions of the report especially the quantitative comparisons. My field observations show the sites to be highly variable in both geomorphology and ecology.
5. There are significant discrepancies in reporting the data which call into serious question the report's data analysis.
6. The reported number of locales from which data were reported do not agree with the reported number of sites.
7. The report shows no differences between natural and mowed sites.
8. The report shows now differences among hand pulled, raked, and filled sites.
9. In every factor reported there is no significant difference between hand pulled, raked, and filled, on the one hand, and natural and mowed sites, on the other hand.
10. There should be studies analyzing the management of the beaches in locations where the natural marsh is present when the lake is low and

absent when the lake is high. Without such specific studies it is not possible to interpret the validity of the reported conclusions.

A PHOTOGRAPHIC ALMANAC OF THE VARIABILITY IN THE GEOMORPHOLOGY OF THE SAGANAW BAY SHORE WETLANDS

PICTURES TAKEN MAY 6, 2006

By
Gary J. Pierce, Ph.D.

Froghome Environmental, LLC

May 8, 2006

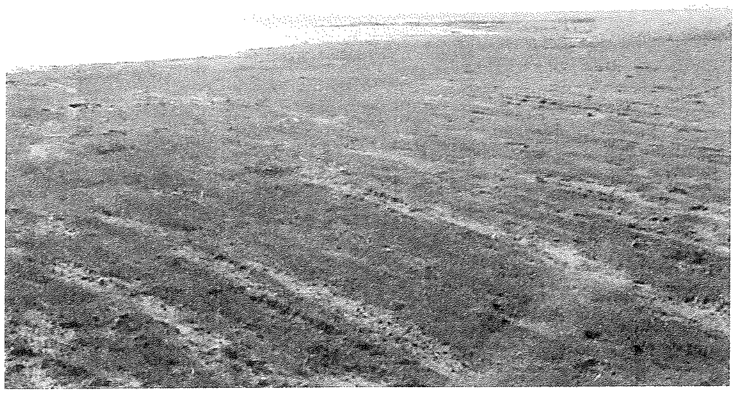

Figure 1 West Shore. Whites Beach. Low elevation flat site, mowed. Note vegetation ending at water line. Soil sandy silt. Ephemeral wetland, not present during high water.

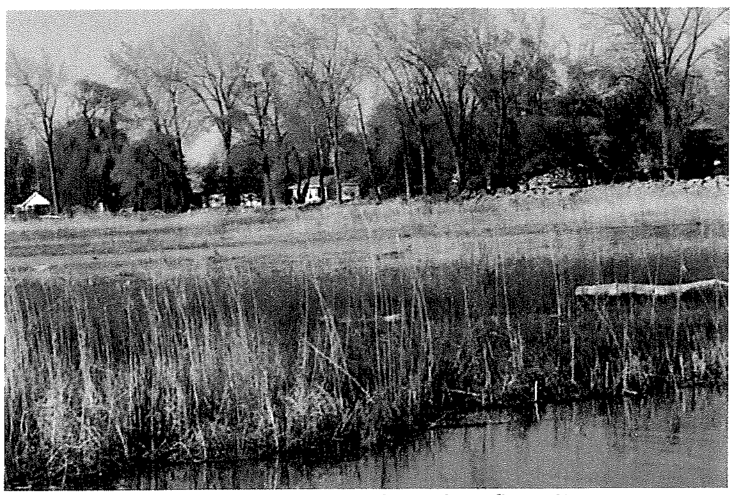

Figure 2. West Shore. Whites Beach. Low elevation flat site, unmanaged. Note vegetation ending at water line. Soil sandy silt. Ephemeral wetland, not present during high water.

Figure 3. West Shore. Pinconning Park. Unmanaged, vegetation sheared by ice action. Vegetation ending at water line and gowing on elevated mud bars in the background. Soil a sandy silt. Ephemeral wetland, not present during high water.

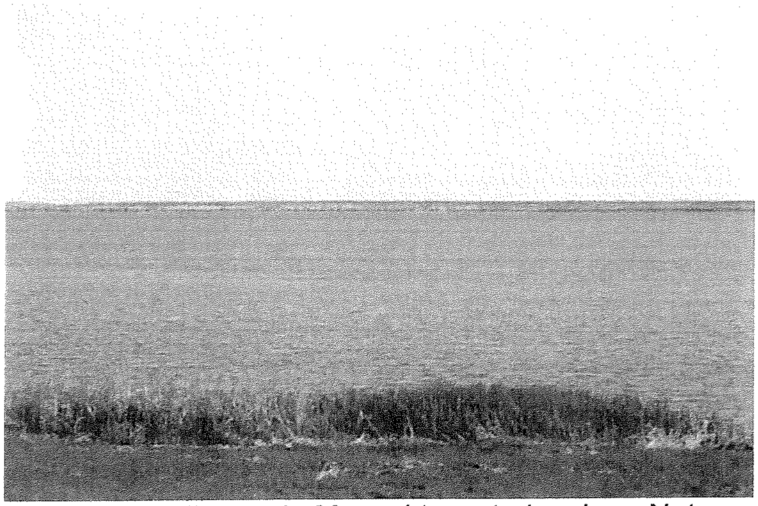

Figure 4. West shore. North linwood. Mowed to water's edge. Not mown vegetation extending slightly into the water. An offshore spit protects this from northerly winds. Soil a sandy silt. Ephemeral wetland, not present during high water.

Figure 5 Linwood south. A steep raked beach. Soil windblown sand.

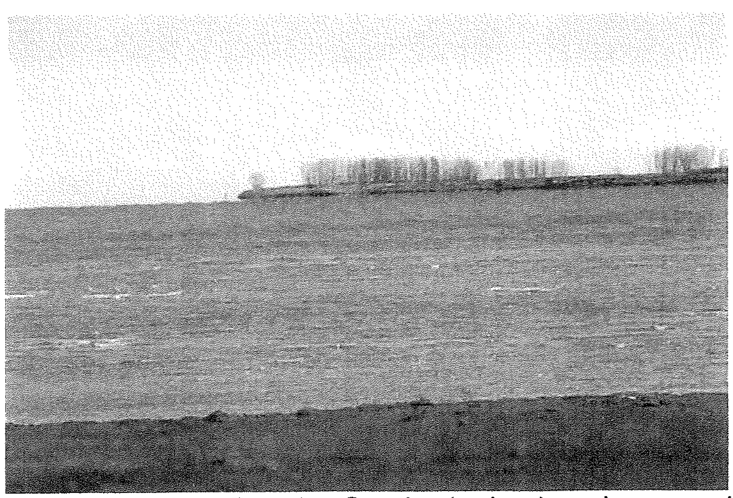

Figure 6. West Shore. Donahue Beach. Gently sloping beach, mowed. Vegetation stops at water's edge. Offshore island provides wave protection. Soil silty sand, windblown. Ephemeral wetland, not present during high water.

Figure 7. East shore Bay Shore. An untreated protected shore with vegetation extending into the water. A permanent wetland.

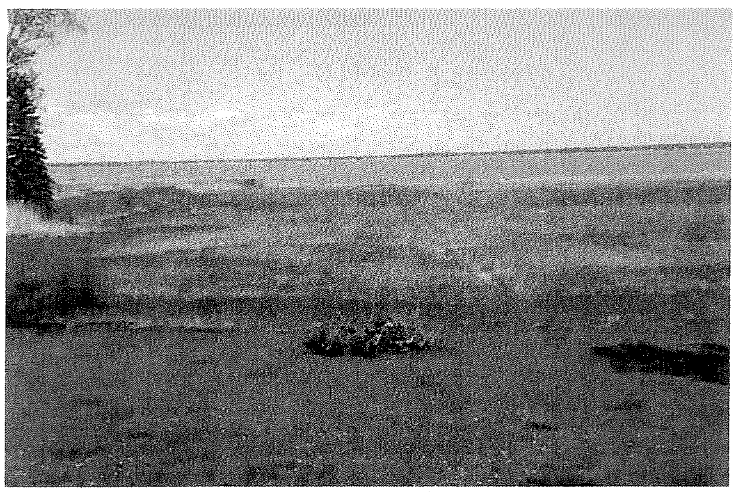

Figure 8. East shore. Waterfowl bay. Low and flat with swales, mowed. Soil silty. Ephemeral wetland, not present during high water.

Figure 9. East shore. South side of Sand Point. Low and flat. Raked, formerly dominated by common reed. Soil sandy.

Figure 10. Same as above showing vegetation extending a few inches into the water on an unraked adjacent parcel.

Figure 11. East shore. Raked park on north side of Sand Point. Soil windblown sand. Gently sloping.

Figure 12. East shore. South of Caseville. Windblown sand. Raked. Steep slope.

Figure 13. East shore. South of Caseville. Windblown sand. Common reed on low dunes, not wetland, is the only vegetation on the shore in this area.

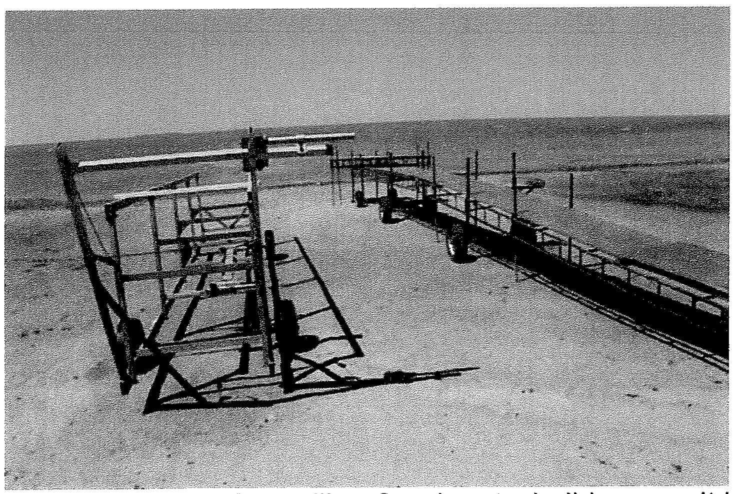

Figure 14. East Shore. South of Caseville. Sand, not windblown as it is kept moist by groundwater discharge. Filled and raked. Gently sloping.

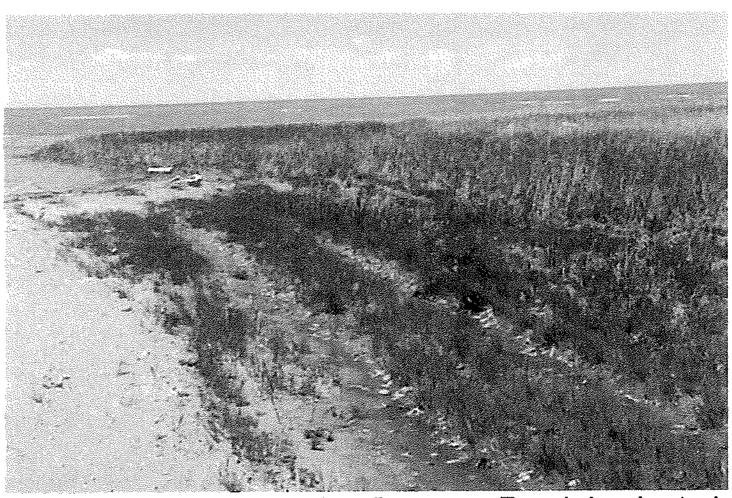

Figure 15. East shore. South of Caseville. Common Reed dominated mown wetland. Sandy soil. Vegetation ends at edge of water. Ephemeral wetland, not present during high water. Gently sloping

A Review of "The Effects of Coastal Wetland Fragmentation on Fish and Invertebrate Communities"

By

Gary J. Pierce, Ph.D.
Froghome Environmental, LLC

May 4, 2006

I have been asked by the board of directors of SOS (Save Our Shoreline) to review the document cited in the title of this report. My task has been to review the document and to comment on it as a scientific report. Before working on this report I have never worked for SOS nor had I formed a professional opinion regarding the management of the great lakes shoreline. I had formed an informal impression that during the past three to four years there has been considerable increase in wetland along the shore of Saginaw Bay in Bay County, Michigan, and that those wetlands appeared to be somewhat of a nuisance for land owners on the shore while being of some interest for the functions and values provided by the wetlands. Previous to preparing this review, I became acquainted with one of the report's co-authors, Keto Gyekis, when he was a summer intern at the Pierce Cedar Creek Institute in Barry County, Michigan. I was had never seen nor been aware of this report until asked to review it by SOS.

My comments here are not complete as my review of the report is ongoing and I will be preparing a more detailed commentary covering additional issues and expanding my comments on some of the issues cited below.

The Effects of Coastal Wetland Fragmentation on Fish and Invertebrate Communities (The Report) presents a large body of research on the water chemistry, invertebrates, and fish populations of dozens of locations on the shores of Grand Traverse Bay, Saginaw Bay and a few other locations in Northern Lakes Michigan and Huron. Thousands of measurements are presented by the authors at two important Michigan research institutions. The report provides 58 figures, 10 tables, and 10 appendices all together amounting to over 160 pages. The primary authors of the report Donald G. Uzarski (Grand Valley State University) and Thomas M. Burton (Michigan State University) are both experienced published researchers of the shoreline habitats of Michigan's great lakes. The report provides an, at first, impressive view of the topic.

The basic form of the report is to provide in order:
Executive Summary,
Methods,
Results and Discussion,
Summary and Conclusions
References

In three separate sections are provided:
Figures
Table
Appendices

Using standard scientific reporting language and methods, the report provides discussions of water chemistry, invertebrates, and fish in paired sites located on the great lakes' shores. It is on examining the report more closely that a litany of problems with the report, research methods, and consequently the conclusions arise.

The report exhibits a number of problems that individually and collectively suggest that the results as reported should be viewed with a serious degree of skepticism.

Editorial factors

Among those are editing problems. The report has no date of completion or submission. The report contains a significant number of typographic errors. Appendix D, and Figures 10, 12, and 34 are missing from the downloaded version of the report from the DEQ website, and a number of the figures are illegible. In the correspondence analyses many of the figures can not be read. Figures 9, 22, 39, 45, 46, 47, 54, and 56 range from extremely difficult to impossible to read because the computer printouts that are the figures have data point names overlapping and obscuring one another.

Site selection factors

Site selection and reporting provide a major source of error and difficulty in understanding and interpreting the report. In a report of this nature comprising data collected at several locations spread over thousands of square miles of landscape it is critical that the data collection sites be enumerated and located on a map and coordinates given. In Michigan, we have an elegant system of township, range, and section. As well as longitude and latitude that could readily be used to locate the sites. Appendices F and I do provide coordinate to some, but not all, of the study sites. For each of the sites a table should, as a minimum, list the following:

- The name of the site
- Any coded designation for the site
- The nature of the vegetation on a scale from none to dense
- The dominant vegetation species
- The size of the overall marsh for the reference wetland
- The size of the disturbed area for the anthropogenic site
- The presence of additional disturbed areas adjacent to the site
- The current use of the site
- The nature of the disturbance for the anthropogenic sites
- The code for the site with which each site is paired
- The distance between the reference and the paired anthropogenic site
- The kind of data collected at each site

- The year that data was collected for each site

Photographs of the sites would also be very helpful in interpreting the data. In each of the comparisons made in the results section it is difficult, often impossible, to know what is being compared; this site information is a critical omission of the study.

In selecting the sites page 7, paragraph 2, line 8 of the report states "...we selected adjacent or nearby intact wetland habitat as a reference" for sites where "beach manipulation" had occurred. No list or text indicating what is meant by nearby is included. This is a critical error especially if the sense of nearby is quite different for the research team and the reader/user of the report. Further, on page 6, line 16 of the report indicates that "...making **pair-wise comparisons** between manipulated habitats and **adjacent** reference habitats, were **the primary objectives** of this research project." [my emphases]. Now looking at Figure 7, the cited locations include seven reference and anthropogenic sites. Looking at these sites and their locations the sites are neither pair-wise nor adjacent and the locations of more than one of the anthropogenic sites is miles from the nearest reference site, clearly neither adjacent nor nearby. It is not clear to me if the research protocol was not followed during the work or if the methods are reported incorrectly. Other significant discrepancies between the methods and the reporting are enumerated below.

In the companion paper (by Dennis Albert) cited in the report there is the statement regarding paired site selection that the pairs should be "within an ecologically similar area of shoreline" (page 5, 2nd paragraph). By suggesting that the paired sites must be adjacent or near one another the report acknowledges that distant sites are inappropriate but neither says why nor describes the spatial relationships of the sites of the sites. By failing to address the criteria for pairing sites and include ecological similarity as a criterion, the report endangers the statistical assumptions for its analyses. The statistical basis for the report is that the sites being compared will be different because of anthropogenic factors of shoreline treatment. When the sites are not adjacent and ecologically equivalent, statistical differences and similarities may well be because of unsuspected and unknown ecological factors other than anthropogenic treatment and its consequences. The foundation for ecological reports comparing different sites is that the comparison is of known causal factors. Without describing the spatial and ecological justification for picking sites to compare the integrity of pair-wise reports is seriously compromised. The report fails to discuss in anyway the pair-wise ecological equivalence of the selected sites.

Statistical analyses factors

The statistical techniques cited in the methods section exhibit a number of discrepancies with the report and problems with the analysis. These may be exclusions of descriptive material, or they may be flaws in the analysis. Both appear to be the case, but it is not possible to determine where a problem lies in each instance. The following discussion is not complete but brings forward some of the most troubling uses and misuses of statistics. Fundamental problems lie in the following areas:

- failing to show the results of tests promised in the methods section
- providing consistent information in statistical analyses
- sample size
- selecting and staying with a particular level of significance
- using parametric vs. nonparametric tests
- Lack of specificity regarding selection made in the statistical test procedures.

In general, the use of statistics has been inconsistent among the various analyses applied to the data, and no discussion for the inconsistencies is provided.

In the methods section statistical tests to determine the importance and reliability of data are indicated to have been used. For example on page 11, paragraph 3, line 10, tests to apply to the Quatrefoil light trap data are indicated as "...we conducted parametric and nonparametric tests(Kruskal-Wallis, Mann Whitney U, ANOVA, paired t-tests and student t-tests)...." In analyzing the data on pages 20, 21, and 22 no use is made or mentioned of any of these tests and no tables or figures indicate the use of these on the data. Either the tests were not performed or they were performed and the results are not shown. In either case, a reader of the report would be justified in surmising that the test data are not shown because they fail to support the researchers' hypotheses. This would be an exceedingly harsh and possibly unsupportable judgment, but inescapable in asking the question of why were results of these test not shown unless the authors of the report supply some explanation.

The use of statistical analyses has not been consistent nor have the results been fully supplied. In using regression equations to supply interpretation of trends in some data along transects the data are not reported consistently or discussed fully. In Figures 10 through 20, regression is used to show the relationship between water quality parameters and distance into the marsh. The regression line and values for both r^2 and p are indicated in the figures and/or accompanying text the r statistic is missing. In a similar analysis for larval fish abundance shown in Figures 48 through 53 and the accompanying text no regression line is shown and neither r or r^2 values are indicated but the p values are given. The value r^2 is important because it indicates something about the scatter of data; that is, how variable from the regression curve are the predicted values. At no point is this scatter discussed in the report, making it difficult to understand the meaning and importance of the regression lines.

At no point is sample size and its importance discussed in the report, and for many analyses the sample size is quite small. An example is that in Figures 49 and 59 only one set of measurements from 4 and 2 sites respectively are shown. No discussion of the statistical consequences of these very small samples is given. On page 7, paragraph 3, the report indicates that only three wetlands were sampled in Grand Traverse Bay in 2004. These three were to represent that area for the report discussing paired samples of mowing, raking, and boat channeling each with a reference wetland. No indication that the results might not be characteristic of the total picture of wetlands in Grand Traverse Bay is indicated despite the inevitability of that conclusion.

The authors indicate on page 10, fourth line from the bottom, that 0.05 is the probability level to show the significance of statistical tests throughout the research. This means that for the test in question it will be said to show significant differences if the probability of getting the same results by chance alone are 5% or less. Thus probability levels of greater than 0.05 do not show significance. On page 17, third from the last line indicate a test as not quite significant. By there own criterion the result of 0.104 is simply not significant. In another instance beginning on the last line of page 20 "Statistical significance of these relationships was marginal ($p=0.086$ and 0.070 ...." Again according to their own criteria the results are simply not significant. In Figures 50, 52, and 53, values of p greater than 0.05 are indicated to show significant effects. Accepting such "marginal" results as meeting the criterion is the same as saying that a conclusion is not significant because the test criterion (0.05) is barely met. Good science using statistical tests accepts the results or discusses why it might be appropriate to accept a different level in a particular case. The report does not provide such a discussion. The reader of such an interpretation may well question the objectivity of the work.

In the methods section both nonparametric and parametric methods are discussed. Non parametric tests are appropriate when there is a low probability that the data being tested exhibit a normal distribution. This happens when data is indeed skewed, when the sample size is very small, and when there are a lot of zero data points. In order to use parametric tests it is necessary to test the data for normality. Although the methods section talks about both types of tests no mention and discussion of the normality of data is included.

In the methods section for the larval fish analysis, there appears the statement that "... for each analysis we included only those sites where sample abundances for the taxon under investigation were high enough to ensure that we were accurately representing the taxon's occurrence in the community." (page 11, paragraph 3, line 12) On page 20, five lines from the bottom the statement is made "Variability among the 12 marshes that contained enough banded killifish to analyze...." In no place is this threshold defined. In statistical analysis such thresholds must be defined else there is a strong possibility of introducing bias by subjectively defining the threshold. Defining this threshold comes into play in the larval fish analysis on page 20.

Figures and data interpretation factors

In the figures and parallel text interpretations, there are important errors in data transcription and data interpretation. These, when added together, bring into question the methods and care taken in handling data for the report and consequently the conclusions of the report.

The larval fish data in Figures 48 through 53 have a number of errors including typographic errors, transcription errors, and errors in interpretation. My Table 1, following, indicates the number of sites that showed presence of the fish species in the report's figures 48 through 53.

In Table 1, here, the actual number of sites shown in the report's figures is, in all cases but one, fewer than the actual number of sites with that species as shown in Appendix J. Apparently, this discrepancy is due to the reporting criterion discussed above, i.e.; "… for each analysis we included only those sites where sample abundances for the taxon under investigation were high enough to ensure that we were accurately representing the taxon's occurrence in the community." In order for yellow perch to have 7 reported sites in Figure 48 instead of the 9 sites in which the fish were found, two sites with low numbers of fish had to be excluded. Table 1 shows that sites with fewer than 5 individuals reported were excluded; apparently more than 4 larval fish were necessary in order for a site to be included. Using the same procedure, the threshold for smallmouth bass sites with 2 fish was excluded and a site with 4 fish was included (inconsistent with the yellow perch criterion). For largemouth bass and carp, sites with 3 or fewer fish were excluded. For Johnny darter, one site with 1 fish was included while two sites with 1 fish were excluded, and the threshold level for this species was 1 fish. There appears to be no standard for how few fish larvae are required to have been trapped at a site for that site to be excluded.

The banded killifish data present a different picture. Here only 9 sites are reported in Appendix J to have fish (the number 10 in the table is because one site was sampled twice). Nevertheless, 12 sites are reported on Figure 51 and that number is repeated in the text. If the adult banded killifish reported in the juvenile fish portion of Appendix J were reported as larval fish in the figure, then the total would rise to 12 sites, but one site would be reported twice. In addition, the juvenile fish sites show 2 fish in one sample and 1 in the other. One or both of these should have been excluded because of the threshold discussed in the previous paragraph.

Table 1. Actual numbers of sites for six larval fish species, and the number indicated in the report plus the number of sites with very low numbers of fish larvae. Data from Figures 48 - 53 and Appendix J.

Species	Number of Actual Sites	Number Reported In Figures	# of Larvae per Site (Number of Sites)					
			1	2	3	4	5	>5
Yellow perch	9	7	0	1	0	1	0	7
Smallmouth bass	6	4	1	1	0	1	0	3
Largemouth bass	4	2	1	0	1	0	0	2
Killifish*	10	12	0	0	0	0	1	9
Johnny darter	6	4	3	1	0	0	0	2
Common carp	11	8	2	0	1	0	0	8

* Killifish Actual Sites includes one site sampled twice.

Another significant problem with Figures 48 through 53 is that the transects reported on the abscissa are not the same for each site examined. As a result the sample size decreases for some of the sites as the distance into the wetland increases. As an example, for smallmouth bass, the transects range from 40 to 50 meters for the anthropogenic data and from 30 to 50 for the reference data. At no point in the text discussing these tables is this discrepancy explained or mentioned.

An annoying feature of Figures 48 through 53 is that the color coded variance bars on the figures are not color coded consistently. For example in Figures 48, 50, 51, and 53 the variance bars are color coded red for the anthropogenic sites and blue for the reference sites. But in Figures 49 and 52 the bars are all the same color.

In interpreting Figures 48 through 53 the text states on page 20, paragraph 3, line 3, "No significant relationships [with distance into the marsh] were found for the anthropogenic transect alone." This statement is confirmed in the discussion for each of the six species except for largemouth bass where the relationship is said to be significant for the anthropogenic transect (page 20, paragraph 6, line 2). There is a contradiction between these two paragraphs. When examining the same information on Figures 48 through 53, the interpretation of the anthropogenic transects is quite different from the interpretation in the text.
The description for each anthropogenic transect from the tables is as follows:

- Fig. 48 "...some marshes show great 'edge effect'...."
- Fig. 49 "Large edge effect in all 4 marshes."
- Fig. 50 "large 'edge effect' (p=0.102)" (This p=0.102 violates the report's standard for determining significance (p=0.05)).
- Fig. 51 "small 'edge effect'"
- Fig. 52 "Positive 'edge effect' (p=0.07)" (This, again, violates the report's standard for significance.)
- Fig. 53 "large 'edge effect' (p=0.184)" (Again, the report's standard for significance is violated.)

The larval fish analysis reported in Figures 48 through 53 involves six species, yellow perch, smallmouth bass, largemouth bass, Johnnie darter, banded killifish, and common carp. According to page 20, "Only those taxa collected in 10 or more traps were analyzed." The raw trap data for the larval fish appears in Appendix J which shows data for 21 taxa. The six species analyzed all show in more than 10 traps. Additionally, Lepomis shows in 23 traps, rock bass in 13 traps, Cyprinidae in 41 traps, and brook stickleback in 11 traps. There is no indication why the additional four species meeting the stated threshold for analysis are not discussed. Without a complete discussion it is not possible to understand the results from the study.

The fyke net collection of fish from Grand Traverse Bay and Saginaw Bay are shown in Figures 45 and 46. The careless preparation of these figures has made it exceptionally difficult to interpret them. However, it is clear from the figures that there is overlap in the first two dimensions of the reference and anthropogenic wetlands.

The diagrams appear to be raw computer printouts and are very difficult to read without considerable interpretation. There are printed symbols and dots graphed in each of the figures, normally the dots would represent the locations of the graphed points and the labels would correspond one for one with the dots. There is no information about the Figure labeling.

Frequently when data sets are simple and small as in the Grand Traverse Bay wetlands there can be more than one point at a single coordinate. In figure 46 this appears to be the case, but where is the dot for the groomed site in the upper left corner of the figure. There are three locales on the graph. One in the lower right has two reference sites and one groomed site, and according to the report the groomed site is with the reference sites because it has some vegetation, but the ungroomed site in the lower left is also represented to have vegetation but it does not separate from the groomed site. Another confusing aspect of the graph is that Table 7 lists the sites represented in this graph and includes three reference sites, but only two reference wetlands are on the figure. Where is the third? Table 7 shows two groomed and one ungroomed wetland, but the graph shows three groomed sites. Is the boat channel indicated in the table the third groomed site? Fundamentally this graph without considerable improvement in presentation and information about the graphing is difficult to interpret. However, it is perfectly clear that two of the three reference sites overlap. Such overlap especially in small data sets usually indicates that there are no significant differences among the sites.

Figure 45 representing fish in Saginaw Bay provides the same difficulties. It is impossible to correspond the labels to the points. There is clear overlap among the points that are indicated as distinct. The list of species that are more common in reference sites is 12 of the 25 species sampled. This suggests in the obverse that there are 13 species that are more common in the anthropogenic sites or there is no difference. The majority interpretation is not mentioned in an apparent effort to characterize the minority position as being inordinately important.

Nearly all of the correspondence analyses have the same problems with overlap among contrasted sites, and confusing complicated labeling, both without adequate interpretation of the symbols.

Figure 55 shows an additional example of errors in data and indicates one of the disadvantages of using multiple dimensional correlations in an effort to make quantitative judgments. Figure 55 shows two clusters circled and labeled. The upper left cluster is labeled as having "most anthro." But counting the triangles shows that 8 of 18 or only 44% of the anthropogenic traps are in the cluster. This is characteristic of the simple errors that plague this report. Another view of the clustering is seen my drawn reinterpretation of the clusters on Figure 55. The hand drawing is attached to this report. In the hand drawing each cluster has half of the anthropogenic traps and the upper left cluster has 11 of 21 reference traps. This illustrates the problems inherent in interpreting similarities and differences in such analyses when there is overlap in the data. The understanding of the biological phenomena is subject to the subjective and arguable interpretation of the report. Under such circumstances multivariate cluster analysis is frequently a weak tool for finding important differences.

A disconnect between the primary focus of the report and the actual anthropogenic activities

The primary focus of the report is on the effect of fragmentation (anthropogenic influences) on the Great lakes' invertebrate and fish populations. In that regard the study has made both stated and implicit statements about the nature of the anthropogenic influences and the nature of the current marshes on the great lakes shores, especially in Grand Traverse Bay and Saginaw Bay. Those statements are inconsistent with observations that I made on both the eastern and western shores of Saginaw Bay. On May 6, 2006, I visited more than twenty locations on Saginaw Bay and observed more than 100 areas of anthropogenic activities as well over 20 locations where no anthropogenic activities are apparent. I observed, on the beaches and shores undisturbed wetlands, raked wetlands, mowed wetlands and filled wetlands.

Page 14, last line, of the report indicates that the input of ground water into the wetlands is the normal condition. In my observations I only observed groundwater discharge at two of the twenty locations that I visited. The influence of ground water appears not to be a significant influence on the biology or the chemistry of the wetlands on the great lakes shores. This is contrary to the statements in the report explaining groundwater chemistry.

In examining over 100 properties with anthropogenic effects, I observed no wetlands with any vegetation extending more than a few inches laterally into the water. The mowed, filled, and raked wetlands and the unmanaged wetlands within a few hundred yards of the points I entered onto the shoreline did not significantly extend into the water. The invertebrate samples and the fish samples could not then reflect the influence of the anthropogenic effects within these or similar wetlands. I can only conclude that such samples discussed in the report represent atypical rather than the normally encountered wetlands where anthropogenic effects occur. On the vast majority of anthropogenic property's wetlands where vegetation existed either before or after management, the influence on invertebrates and fish measured by the study could not have been measured within the wetlands because there was no water. Most of the sampling methods required flooded areas and reported results were from flooded zones within wetlands. The fyke net results were from locations next to the wetlands in deep water. Clearly the results do not fairly represent typical anthropogenic sites.

Conclusions:

1. The report contains numerous significant errors, exclusions, and inconsistencies making it virtually impossible to determine the scientific accuracy of the methods, results, and conclusions of the report.
2. Because of the difficulty in interpreting the accuracy of the report, it is inappropriate to comment on the accuracy of the conclusions of the report except to say that the conclusions should be viewed as representing a fundamentally flawed reporting process.
3. The errors in the report do not imply anything positive or negative regarding the data collection and underlying science of the report. Rather the errors are in the reporting of the data and I am unable to make any judgments regarding the underlying science.
4. Because of the numerous fundamental flaws in the report, I am unable to make any conclusions, from the report, about the effects of any beach grooming activities.
5. The invertebrate samples and the fish samples can not represent the influence of the wetland treatments because the treatments are not conducted in the water where the invertebrates and the fish live and were sampled. Secondary influences of water chemistry are excluded by the report which shows no significant water chemistry differences between anthropogenic and reference sites.
6. The locales that provide the possibility for shoreline fish habitat are not typically groomed because of the difficulty of grooming under water.

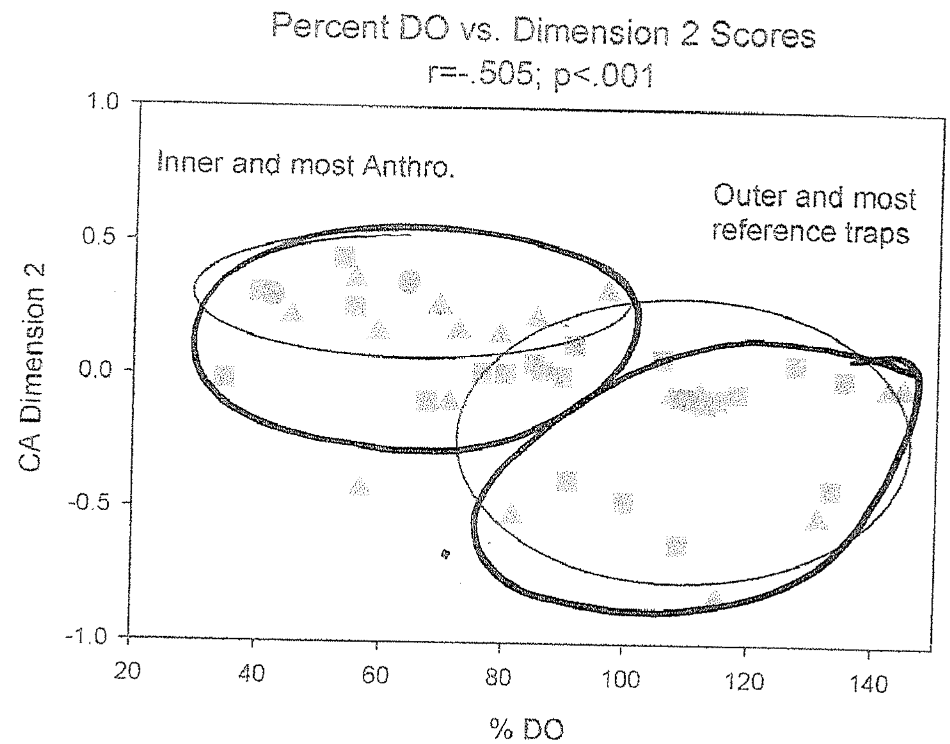

Figure 55. Correlation between CA dimension 2 scores for microinvertebrates (sampled with quatrefoil light traps) and percent saturation of dissolved oxygen in coastal wetlands (2004). Green squares represent light traps along reference transects, red triangles represent anthropogenic transects and blue circles represent corner traps.